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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

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HALFTONING FOR MULTI-PASS
RENDERING
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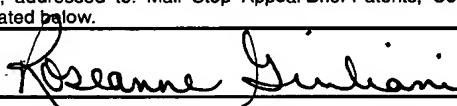
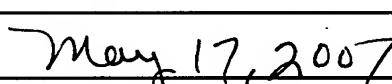
AMENDED APPEAL BRIEF UNDER 37 C.F.R. §41.37

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Dear Sir:

This Amended Appeal Brief is in furtherance to the Notice of Appeal that was mailed to the U.S. Patent and Trademark Office on December 18, 2006, in the above-referenced patent application and responsive to the Notification of Non-Compliant Appeal Brief mailed April 20, 2007.

The fees required under 37 C.F.R. §1.17 and any required petition for extension of time for filing this brief and fees therefor were addressed in the transmittal letter that accompanied the Appeal Brief mailed on February 20, 2007.

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THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE HONORABLE BOARD OF PATENT APPEALS AND
INTERFERENCES

In re the Application of

Sharma et al.

Application No.: 10/044,468

Examiner: Thompson, James A.

Filed: January 11, 2002

Docket No.: A1160-US-NP
XERZ 2 00445

For: SYSTEM AND METHOD OF HALFTONING FOR MULTI-PASS
RENDERING

BRIEF ON APPEAL

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Application No. 10/044,468

I. REAL PARTY INTEREST

The real party in interest in the subject Appeal is Xerox Corporation of Stamford, Connecticut, the assignee of record for this patent application by way of assignment recorded in the U.S. Patent and Trademark Office at Reel 012498, Frame 0903.

II. RELATED APPEALS AND INTERFERENCES

There are no prior or pending appeals, interferences or judicial proceedings, known to Appellant, Appellant's representative, or the Assignee, that may be related to, or which will directly affect or be directly affected by or have a bearing upon the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-31 are on appeal.

Claims 1-31 are pending.

No claims are allowed, and no claims are objected to only for being dependent from a rejected base claim, but are otherwise allowable.

Claims 1-31 are rejected.

No claims are withdrawn from consideration.

No claims are canceled.

IV. STATUS OF THE AMENDMENTS

No Amendments were filed.

V. SUMMARY OF THE CLAIMED SUBJECT MATTER

The invention of independent claim 1 is directed to a method of halftoning for multi-pass rendering in which different pixel locations **24** are rendered in each pass. The method includes restricting a substantial majority of the pixels turned on **40** to render a tone at an image location to the minimum number of passes required to produce the tone. The invention of claim 1 is described in the Specification on page 3, paragraph [010] - page 4, paragraph [013], and page 5, paragraph [029] - page 17, paragraph [060], and is illustrated in Figures 1 - 12, with perhaps particularly relevant portions being page 8, paragraph [037] - page 10, paragraph [041] and Figures 4 and 5, and page 14, paragraph [054] - page 16 paragraph [058]. The claimed "minimum number of passes required to produce the tone" will vary and depend on both the tonal intensity value of the tone and the number-pass printing used (ie. two-pass, four-pass, etc.) as described on page 12, paragraph [047] - page 13, paragraph [049].

The invention of dependent claim 2 is directed to the method of halftoning of claim 1 wherein approximately 75% or more of the pixels turned on to render a tone at an image location are restricted to the minimum number of passes required to produce the tone, as described in the specification on page 13, paragraph [049].

The invention of dependent claim 3 is directed to the method of halftoning of claim 1 wherein approximately 90% or more of the pixels turned on to render a tone at an image location are restricted to the minimum number of passes required to produce the tone, as described in the specification on page 13, paragraph [049].

The invention of independent claim 25 is directed to a method of generating a stochastic halftone screen for multi-pass rendering in which different pixel locations **24** are rendered in each pass. The method includes restricting a substantial majority of the pixels turned on **40** to render a tone at an image location to the minimum number of passes required to produce the tone. The invention of claim 25 is described in the Specification on page 5, paragraph [029] - page 13 paragraph [051], and is illustrated in Figures 1 - 7 with perhaps particularly relevant portions being page 8, paragraph [037] - page 10, paragraph [041] and Figures 4 and 5.

The invention of dependent claim 26 is directed to the method of halftoning of claim 25 wherein the restricting step includes re-ordering the pixel turn-on sequence

as described in detail on page page 8, paragraph [037] - page 10, paragraph [041] and Figures 4 and 5.

The invention of independent claim 28 is directed to a system **200** for halftoning for multi-pass rendering of an image having pixels **24** which renders different pixels in each pass. The system **200** includes means for restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone as described in the Specification on page 17, paragraph [061] - page 18 paragraph [065], and illustrated in Figure 13. The means for restricting include a halftone generator **210** having the ability to re-order a stochastic screen pixel turn-on sequence **28** as described on page 17, paragraph [062], page 8, paragraph [037] - page 10, paragraph [041] as illustrated in Figures 3 - 5, and page 14, paragraph [054] - page 16 paragraph [058]. The means for restricting can also include a halftone generator **210** with the ability to add a zero mean bias signal **b(x,y)** to a partitioned input pixel tone value, where the zero mean bias signal (**b(x,y)** **being +D or -D**) is based on which partition **S1, S2** contains the partitioned pixel tone value as described in page 14 paragraph [054] - page 15 paragraph [055], and illustrated in Figure 10. The means for restricting can also include a halftone generator **210** with the ability to add a zero mean bias signal (**b(x,y)** **being +D or -D**) to the threshold value **T(x,y)**, rather than the input pixel tone value, as described in page 15 paragraph [056] - page 16 paragraph [058], and illustrated in Figures 11 and 12.

Dependent claim 29, depending from independent claim 28, claims means for partitioning a stochastic screen pixel turn-on sequence **28** into a plurality of partitions **S1, S2, 24a, 24b** with each partition corresponding to a different pass as embodied by the halftone generator **210** in Figure 13 and described on page 8 paragraph [036]. The restricting means **210** includes means **210** for re-ordering the stochastic screen pixel turn-on sequence **28, 30** to restrict a substantial majority of the pixels turned on **40** to render a tone to the minimum number of passes required to produce the tone, is described on page 8, paragraph [037] - page 10, paragraph [042] as illustrated in Figures 3 - 5.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

Whether claims 1-3, 25-26, and 28 are unpatentable under 35 U.S.C. §102(e) as being anticipated by Gotoh (US Patent Application Publication 2002/0024548 A1), hereinafter Gotoh.

Whether claims 4-10, 27 and 29 are unpatentable under 35 U.S.C. § 103(a) over Gotoh in view of Wang (US Patent 6,014,500).

Whether claims 11-14 are unpatentable under 35 U.S.C. § 103(a) over Gotoh in view of Wang (US Patent 6,014,500) and obvious engineering design choice.

Whether claims 15-24 and 30-31 are unpatentable under 35 U.S.C. § 103(a) over Gotoh in view of Shiau (US Patent 5,880,857).

VII. ARGUMENTS

The claims at issue do not stand or fall together. Specifically, claims 1, 25 and 28 each recite separately patentable subject matter.

The Examiner rejected claims 1-3, 25-26, and 28 under 35 U.S.C. §102(e) as being anticipated by Gotoh. The Examiner rejected claims 4-10, 27 and 29 under 35 U.S.C. § 103(a) over Gotoh in view of Wang. The Examiner rejected claims 11-14 under 35 U.S.C. § 103(a) over Gotoh in view of Wang and obvious engineering design choice. The Examiner rejected claims 15-24 and 30-31 under 35 U.S.C. § 103(a) over Gotoh in view of Shiau. The appellant respectfully disagrees.

A. Claims 1-3, 25-26, and 28 are not anticipated by Gotoh

The Gotoh reference does not render unpatentable the subject matter recited in claims 1-3, 25-26, and 28. The combination of Gotoh and Wang does not render unpatentable the subject matter recited in claims 4-10, 27, and 29. The combination of Gotoh and Shiau does not render unpatentable the subject matter recited in claims 15-24 and 30-31. Details of Appellant's arguments are provided in more detail below.

1. Claim 1

This application, and the embodiments as claimed therein, relates to a method of halftoning for multi-pass rendering, wherein different pixel locations are rendered in each pass. The method comprises restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone. Claim 1 is patentable over Gotoh, since Gotoh does not teach or suggest this claim limitation.

In rejecting claim 1, the Examiner stated that in the example provided by Gotoh, half of the turned-on pixels are printed in two passes, with only one-quarter of the turned-on pixels being printed in a single pass, and thus three-quarters of the turned-on pixels are restricted from being printed. (The Examiner references Gotoh, paragraph 71). However, this is not claimed in claim 1, which claims restricting the substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

As described in paragraph [002] of the Background of the Appellants' application as filed, it is understood that most digital printers operate in a binary mode, i.e., for each tonal separation, a corresponding spot is either printed or not printed at a specified location or pixel. Digital halftoning controls the printing of tonal spots, where spatially averaging the printed spots of one or more tonal separations provides the illusion of the required continuous contone.

As described in paragraphs [045] – [046] of the Appellants' application as filed, the tonal intensity value, also known in the field of halftoning for image rendering as the tone, of the input image is used to determine which pixels are rendered, that is actually turned on resulting in a printed output, and those which remain off and thus are not printed. In the example provided in specification in paragraphs [029]-[046], which is simplified for clarity, a 2-bit image having a tone with a constant tonal intensity value of 25%, represented as 1 out of 0-3 was used. The restricting step was accomplished by re-ordering the pixel turn on sequence as shown in Figures 4 and 5, which was then converted to threshold values as shown in Figure 6. With a given tone of 25% tonal intensity value, for example, only the 1's are turned on or rendered resulting in black pixels represented by the cross-hatched squares **40** in the halftone output pattern **42** illustrated in FIG. 7. The black pixels **40** occupy **S1** screen elements **24a** and are printed in only one pass making the rendered pattern less sensitive to inter-pass mis-registration than known methods of halftoning.

In section 1 of the Final Office Action containing the Examiner's reply to the Appellants' Response, the Examiner questioned what is considered the "minimum" number of passes, stating that the "minimum" number of passes is different depending on the construction of each particular printing system. The Examiner stated that the minimum number of passes that a particular system requires to render a tone would read on the limitation disputed by the Appellants, whether that number of passes is 2, 10, 1000 or any other number of passes, and as such, the system taught by Gotoh using two passes uses the minimum number of passes and anticipates claim 1.

The Appellants respectfully maintain that claim 1 particularly points out and distinctly claims a patentable method of halftoning for multi-pass rendering. The claim limitation at issue is "the minimum number of passes required to produce the tone". This limitation must be read in the context of halftoning and multi-pass

rendering. In the field of halftoning for multi-pass rendering, wherein different pixel locations are rendered in each pass, the minimum number of passes required to produce any particular tone depends on the number of passes the multi-pass system makes to render a tone of 100% tonal intensity value (i.e. a 2 pass system, 4 pass system, etc.) and the tonal intensity value of the tone being produced. For example, in a 4-pass rendering system, the minimum number of passes required to produce a tone having a tonal intensity value of 25% or less, is 1 pass.

Gotoh teaches a two pass multi-pass printing system, but uses both passes to render tones, regardless of tonal intensity value of the tone. Therefore, Gotoh does not teach or suggest a method of halftoning comprising restricting the substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

Gotoh teaches that divided recording processes of multi-pass printing using 2 passes may result in an imbalance in the number of nozzles used (see paragraphs [0076]-[0077]). However, this imbalance does not meet the claim limitation of restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

Gotoh seeks to provide greater uniformity of nozzle usage as discussed, for example, in paragraphs [0078]-[0082], among others. Gotoh teaches manipulating the grayscale pattern shown in Figure 8 which consists of 8x16 dots for displaying 128 gray levels. This gray scale pattern consists of 2 blocks of gray scale patterns 8A and 8A' having 8x8 size as shown in Figure 25. The block 8A' formed by vertically divided blocks 8B and 8C. As shown in Figures 8 and 26, the block 8A' formed of blocks 8B and 8C is obtained by switching upper and lower blocks obtained by dividing blocks A into upper and lower blocks. In this way, the positions at which dots are concentrated in the respective block gray scale pattern shown in Figure 25 are scattered in the direction of array of the multinozzles 602 shown in Figure 17. As a result, the frequencies with which the multinozzles 602 are used become uniform and continuity of the gray scale can be enhanced. Therefore, Gotoh does not teach or suggest the invention as claimed in claim 1. Rather, by teaching the uniform use of print nozzles in this manner, Gotoh teaches away from claim 1 as claimed.

The Examiner has not provided prime facie support of Gotoh teaching this claim limitation as claimed in claim 1. Applicant maintains that Gotoh does not teach

or suggest restricting the substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

For these reasons, claim 1 patentability defines over Gotoh and is therefore patentable. Further, claims 2-24 depending from claim 1 are also patentable.

2. Claim 2

Claim 2 is patentable over Gotoh, since Gotoh does not teach or suggest restricting approximately 75% or more of the pixels turned on to render a tone to the minimum number of passes required to produce the tone for the reasons stated above regarding claim 1.

The Examiner stated in the rejection of claim 2 that Gotoh teach restricting three-quarters (75%) of the turned-on pixels from being printed. However, this is not claimed in claim 2 which claims restricting approximately 75% or more of the pixels turned on to render a tone to the minimum number of passes required to produce the tone. Accordingly, claim 2 is patentable over Gotoh.

3. Claim 3

Claim 3 is patentable over Gotoh, since Gotoh does not teach or suggest restricting approximately 90% or more of the pixels turned on to render a tone to the minimum number of passes required to produce the tone for the reasons stated above regarding claims 1 and 2.

The Examiner stated the Gotoh reference discloses that in the case of 64 nozzles, only 1.5625% of the turned on pixels are printed with a single nozzle. Thus, more than 90% of the turned on pixels are restricted from being printed so that, with two sets of 32 nozzles a tone can be rendered in a minimum number of passes.

However, claim 3 claims restricting approximately 90% or more of the pixels turned on to render a tone to the minimum number of passes required to produce the tone. Gotoh teaches moving pixels to different print nozzles to create uniformity of nozzle usage, but it still teaches making 2 passes (using a plurality of nozzles in each pass) to render a tone regardless of the tone produced. Therefore, claim 3 is patentable over Gotoh for this reason and the reasons stated above with regards to claim 1.

4. Claim 25

Claim 25 is patentable over Gotoh, since Gotoh does not teach or suggest a method of generating a stochastic halftone screen for multi-pass rendering, wherein different pixel locations are rendered in each pass, the method comprising restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

The Examiner rejected claim 25, stating Gotoh teaches printing half of the turned-on pixels in two passes, and thus, only one-quarter of the turned on pixels are printed in a single pass. Therefore, three-quarters of the turned-on pixels are restricted from being printed.

However, this is not claimed in claim 25 which claims restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone. Claim 25, which claims a method of generating a stochastic halftone screen for multi-pass rendering, is patentable for reasons similar to those stated with regard to claims 1-3 above.

The Examiner has not provided prime facie support of Gotoh teaching this claim limitation as claimed in claim 25. For these reasons, claim 25 patentably defines over Gotoh and is therefore patentable. Further claims 26-27, depending from claim 25, are also patentable over Gotoh.

5. Claim 26

Claim 26 is patentable over Gotoh since Gotoh does not teach or suggest partitioning a turn-on sequence into a plurality of partitions corresponding to rendering passes, wherein the restricting step includes re-ordering the pixel turn-on sequence to restrict a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

While Gotoh may teach re-ordering a pixel turn-on sequence, Gotoh does not teach restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone for the reasons stated with regard to claim 1-3 and 25 above. Accordingly, claim 26 is patentable over Gotoh.

6. Claim 28

Claim 28 patentably defines over Gotoh since Gotoh does not teach or suggest a system for halftoning for multi-pass rendering of an image having pixels, wherein different pixels are rendered in each pass, the system comprising, means for restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

The Examiner rejected claim 28 as being anticipated by Gotoh stating Gotoh discloses a system (shown in figure 16 and discussed in paragraph [049]) in which half the turned-on pixels are printed in two passes, and thus one quarter of the turned-on pixels are printed in a single pass. However, this is not claimed in claim 28 which claims means for restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

Claim 28 uses means-plus-function language to define the characteristics of the apparatus for computing properties of an image. In accordance with *In re Donaldson*, 16 F.3d 1189, 1193 29USPQ2d 1845, 1848 (Fed. Cir. 1994) the Federal Circuit has made it clear that means-plus-function language should be interpreted according to 35 USC 112 sixth paragraph. The court held "The plain and unambiguous meaning of paragraph six is that one construing means-plus-function language in a claim must look to the specification and interpret that language in light of the corresponding structure, material, or acts described therein..." As stated above with regard to claims 1-3 and 25-26, Gotoh uses 2 passes to render all tones whereas the minimum number of passes required to produce the tone in a 2-pass system depends on the tonal intensity value of the tone. For this reason, and the reasons stated with regards to claims 1-3 and 25-26, Gotoh does not teach the claimed limitation of means for restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

The Examiner has not provided prime facie support of Gotoh teaching this claim limitation as claimed in claim 28. Claim 28 patentably defines over Gotoh for the reasons stated above and is therefore patentable. Further claims 29-31, depending from claim 28, are also patentable over Gotoh.

B. Claims 4-10, 27 and 29 Would Not Have Been Obvious Over Gotoh in View of Wang

1. Claims 4-10

The Examiner maintains that Gotoh teaches restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone, and the combination of Gotoh and Wang render claims 4-10 unpatentable.

Claims 4-10 patentably define over the combination of Gotoh and Wang since neither reference alone, or in combination, teaches restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone for the reasons stated above with regard to claim 1.

Further, with regard to claim 7 the Examiner stated Wang discloses placing the lowest stochastic screen pixel turn-on sequence values in one partition and the highest stochastic screen pixel turn-on values in another partition (column 7, lines 30-40 of Wang). The Examiner further stated the stochastic screen pixel turn-on sequence values of Wang are partitioned into checkerboard and reverse-checkerboard partitions, and since the first half (S_1) of the turn-on sequence is in checkerboard form, then the first partition must be the lowest stochastic screen pixel turn-on sequence values and the second half (S_2) must be the highest stochastic screen pixel turn-on sequence values.

However, Wang does not teach this. Rather, Wang simply teaches that the stochastic screen S is divided into two subsets, subset (S_1) are the pixels contained in one half of the checkerboard pattern and subset (S_2) are the pixels contained in the other half of the checkerboard pattern. Wang does not teach that the half (S_1) contains the lowest turn-on sequence numbers and the half (S_2) contains the highest turn-on sequence numbers. Therefore, Wang does not teach a re-ordering step of placing the lowest stochastic screen pixel turn-on sequence values in one partition and the highest stochastic screen pixel turn-on values in another partition as claimed in claim 7 and claim 7 is patentable over the combination of Gotoh and Wang.

Further, with regard to claim 9, the Examiner stated Wang discloses re-ordering the stochastic pixel turn on sequence to optimize a merit function. However, Wang teaches the creation of a stochastic screen by optimizing a merit function, but does not teach re-ordering a stochastic pixel turn on sequence.

Further, Wang does not teach obtaining a subsequence for each partition by arranging the pixels within the partition in increasing order of turn-on sequence values, concatenating the subsequences for the different partitions, in any order, to form a single sequence, and renumbering the resulting single sequence in increasing order of turn-on values to obtain the new turn-on sequence as claimed in claim 9.

Accordingly, claims 4-10 are patentable over the combination of Gotoh and Wang for these reasons.

2. Claim 29

Claim 29 patentably defines over the combination of Gotoh and Wang since Gotoh does not teach or suggest means for partitioning the stochastic screen pixel turn-on sequence into a plurality of partitions each partition corresponding to a different pass, wherein the restricting means includes means for re-ordering the stochastic screen pixel turn-on sequence to restrict a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone for the reasons stated with regards to claims 1-3 above.

C. Claims 11-14 Would Not Have Been Obvious Over Gotoh in View of Wang and obvious engineering design choice

1. Claims 11-14

Claims 11-14 are patentable over the combination of Gotoh and Wang and are not an obvious engineering design choice because this combination does not teach the step of restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone for the reasons set forth above with regard to claim 1.

D. Claims 15-24 Would Not Have Been Obvious Over Gotoh in View of Shiau

1. Claims 15-24

Claims 15-24 patentably defines over the combination of Gotoh and Shiau since Gotoh does not teach or suggest restricting a substantial majority of the pixels

turned on to render a tone to the minimum number of passes required to produce the tone for the reasons stated with regard to claim 1 above.

Further Shiau does not teach adding an error diffused from previously processed pixels to the input tone value of a current pixel to achieve a desired pixel value, and comparing the desired pixel value with a threshold value, wherein the restricting step includes adding a zero mean bias signal to the input tone value based on the partition containing the input image pixel as claimed in claim 15. The random noise Shiau adds does not provide a zero mean bias signal to the input tone value based on the partition containing the input image pixel.

Further Shiau does not teach adding an error diffused from previously processed pixels to the input tone value of a current pixel to achieve a desired pixel value, and comparing the desired pixel value with a threshold value, wherein the restricting step includes adding a zero mean bias signal to the threshold value based on the partition containing the input image pixel as claimed in claim 15. The random noise Shiau adds does not provide a zero mean bias signal to threshold value based on the partition containing the input image pixel.

Accordingly, claims 15-24 are patentable over the combination of Gotoh and Shiau for these reasons.

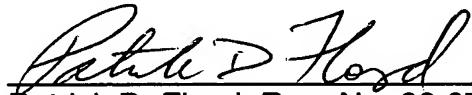
CONCLUSION

In view of the foregoing, Appellant respectfully submits that claims 1-31 patentably define over Gotoh, alone and/or in combination with Wang or Shiau.

Accordingly, it is respectfully requested that the Examiner's rejections be reversed.

Respectfully submitted,
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Date: 5-17-07



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APPENDICES

VIII. CLAIMS APPENDIX

1. (Original) A method of halftoning for multi-pass rendering, wherein different pixel locations are rendered in each pass, the method comprising restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

2. (Original) The method of halftoning defined in claim 1 wherein the substantial majority is approximately 75% or more of the pixels turned on to render a tone.

3. (Original) The method of halftoning defined in claim 1 wherein the substantial majority is approximately 90% or more of the pixels turned on to render a tone.

4. (Original) The method of halftoning defined in claim 1 further comprising:
generating a stochastic screen pixel turn-on sequence; and
partitioning the stochastic screen pixel turn-on sequence into a plurality of partitions, wherein each partition corresponds to a different pass.

5. (Original) The method of halftoning defined in claim 4 wherein the restricting step includes re-ordering the stochastic screen pixel turn-on sequence to restrict a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

6. (Original) The method of halftoning defined in claim 5 further comprising generating a stochastic halftone screen using the re-ordered stochastic screen pixel turn-on sequence.

7. (Original) The method of halftoning defined in claim 5 wherein the re-ordering step includes placing the lowest stochastic screen pixel turn-on

sequence values in one partition and the highest stochastic screen pixel turn-on sequence values in another partition.

8. (Original) The method of halftoning defined in claim 7 wherein the re-ordering step further includes:

- a) replacing the lowest stochastic screen pixel turn-on value before re-ordering contained in one partition with a replacement value which is the lowest stochastic screen pixel turn-on sequence value of all partitions of the screen;
- b) replacing the next lowest stochastic screen pixel turn-on value in the one partition with a replacement value which is the next lowest stochastic screen pixel turn-on sequence value of all partitions of the screen;
- c) repeating step b) until the one partition is filled with the lowest stochastic screen pixel turn-on sequence values of all partitions; and
- d) repeating steps a) through c) to re-order each of the other partitions in turn with the remaining unused replacement values.

9. (Original) The method of halftoning defined in claim 7 wherein the re-ordering step further includes:

- a) obtaining a subsequence for each partition by arranging the pixels within the partition in increasing order of turn-on sequence values;
- b) concatenating the subsequences for the different partitions, in any order, to form a single sequence; and
- c) renumbering the resulting single sequence in increasing order of turn-on values to obtain the new turn-on sequence.

10. (Original) The method of halftoning defined in claim 5 wherein the partitioning step includes partitioning the stochastic screen pixel turn-on sequence into two partitions.

11. (Original) The method of halftoning defined in claim 10 wherein the partitions are designated $S1$ and $S2$ and the merit function is $\tilde{M}(S) = M(S) + w_1 * M(S1) + w_2 * M(S2)$, where $M(S)$ is a merit function suitable for a single stochastic screen and w_1 and w_2 are weighting factors in the range of 2 to approximately 100.

12. (Original) The method of halftoning defined in claim 11 wherein the partitioning step includes partitioning into a checkerboard partition arrangement.

13. (Original) The method of halftoning defined in claim 12 wherein the step of generating a stochastic screen pixel turn-on sequence includes generating a halftone screen for a checkerboard partition such that the pixels can be classified as belonging to the two partitions using the coordinates of columns and rows, i and j , and the mathematical rule

$$\begin{aligned} p(i, j) &\in S1, \quad \text{if } (i + j) \% 2 = 0; \\ p(i, j) &\in S2, \quad \text{if } (i + j) \% 2 = 1; \\ S &= S1 + S2 \end{aligned}$$

and optimizing the merit function

$$\tilde{M}(S) = M(S) + w_1 * M(S1) + w_2 * M(S2),$$

where w_1 and w_2 are weighting factors each in the range of approximately 2 to approximately 100.

14. (Original) The method of halftoning defined in claim 13 wherein $w_1 \approx 3$ and $w_2 \approx 3$.

15. (Original) The method of halftoning defined in claim 1 further comprising:

providing an input image having a plurality of pixels each having an input tone value;

partitioning the input image pixels into partitions wherein each partition corresponds to a different pass;

adding an error diffused from previously processed pixels to the input tone value of a current pixel to achieve a desired pixel value; and

comparing the desired pixel value with a threshold value, wherein the restricting step includes adding a zero mean bias signal to the input tone value

based on the partition containing the input image pixel.

16. (Original) The method of halftoning defined in claim 15 wherein the partitioning step includes partitioning the input image pixels into two partitions.

17. (Original) The method of halftoning defined in claim 16 wherein the partitioning step includes partitioning the input image pixels into a checkerboard partition.

18. (Original) The method of halftoning defined in claim 16 wherein the zero mean bias signal has a value of +D for one partition and -D for the other partition.

19. (Original) The method of halftoning defined in claim 18 wherein the input image tone value can be one of 256 values and the value of D is between approximately 32 and 64.

20. (Original) The method of halftoning defined in claim 1 further comprising:

providing an input image having a plurality of pixels each having an input tone value;

partitioning the input image pixels into partitions wherein each partition corresponds to a different pass;

adding an error diffused from previously processed pixels to the input tone value of a current pixel to achieve a desired pixel value; and

comparing the desired pixel value with a threshold value, wherein the restricting step includes adding a zero mean bias signal to the threshold value based on which partition contains the input image pixel.

21. (Original) The method of halftoning defined in claim 20 wherein the partitioning step includes partitioning the input image pixels into two partitions.

22. (Original) The method of halftoning defined in claim 21 wherein the partitioning step includes partitioning the input image pixels into a checkerboard partition.

23. (Original) The method of halftoning defined in claim 21 wherein the zero mean bias signal has a value of +D for one partition and -D for the other partition.

24. (Original) The method of halftoning defined in claim 23 wherein the input image tone value can be one of 256 values and the value of D is between approximately 32 and 64.

25. (Original) A method of generating a stochastic halftone screen for multi-pass rendering, wherein different pixel locations are rendered in each pass, the method comprising restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

26. (Original) The method of generating a stochastic halftone screen defined in claim 25 further comprising:

generating a pixel turn-on sequence; and

partitioning the turn-on sequence into a plurality of partitions corresponding to rendering passes, wherein the restricting step includes re-ordering the pixel turn-on sequence.

27. (Original) The method of generating a stochastic halftone screen defined in claim 25 wherein the step of generating a pixel turn-on sequence includes optimizing a merit function representative of the halftone texture quality.

28. (Original) A system for halftoning for multi-pass rendering of an image having pixels, wherein different pixels are rendered in each pass, the system comprising, means for restricting a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

29. (Original) The system defined in claim 28 further comprising:

a stochastic screen pixel turn-on sequence generator; and means for partitioning the stochastic screen pixel turn-on sequence into a plurality of partitions each partition corresponding to a different pass, wherein the restricting means includes means for re-ordering the stochastic screen pixel turn-on sequence to restrict a substantial majority of the pixels turned on to render a tone to the minimum number of passes required to produce the tone.

30. (Original) The system defined in claim 28 further comprising:
means for partitioning an input image having a plurality of input pixel tone values into a plurality of partitioned pixel tone values;
means for processing the partitioned pixel tone values to produce a previously processed pixel error diffusion value;
means for processing a current partitioned input pixel tone value including means for adding the previously processed pixel error diffusion value to the current partitioned input pixel tone value to achieve a desired pixel value; and
means for comparing the desired pixel value with a threshold value to produce an output signal for rendering the image, wherein the means for restricting includes means for adding a zero mean bias signal to the current partitioned input pixel tone value, the zero mean bias signal being based on the partition containing the partitioned pixel tone value.

31. (Original) The system defined in claim 28 further comprising:
means for partitioning an input image having a plurality of input pixel tone values into a plurality of partitioned pixel tone values;
means for processing the partitioned pixel tone values to produce a previously processed pixel error diffusion value;
means for processing a partitioned input pixel tone value including means for adding the previously processed pixel error diffusion value to the partitioned input pixel tone value to achieve a desired pixel value; and
means for comparing the desired pixel value with a threshold value to produce an output signal for rendering the image, wherein the means for restricting includes means for adding a zero mean bias signal to the threshold value, the zero mean bias signal being based on the partition containing the partitioned pixel tone value.

IX. EVIDENCE APPENDIX

NONE

X. RELATED PROCEEDINGS APPENDIX

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CONCLUSION

The decision of the GSBCA is vacated, and the case is remanded for a redetermination consistent with this opinion of Sterling's allowable costs of filing and pursuing its protest.

COSTS

As to this appeal each party is to bear its own costs.

VACATED and REMANDED.



In re DONALDSON COMPANY, INC.

No. 91-1386.

United States Court of Appeals,
Federal Circuit.

Feb. 14, 1994.

Applicant for industrial air filtering device patent sought judicial review of decision by United States Patent and Trademark Office (PTO) which sustained examiners rejection of claim on reexamination application. The Court of Appeals, 964 F.2d 732, remanded. PTO sought reconsideration. The Court of Appeals, Rich, Circuit Judge, held that: (1) means-plus-function language in claim must be construed in light of specification and interpreted in light of corresponding structure and material, or acts and equivalents to extent that specification provides a disclosure regardless of context, and (2) flexible wall, diaphragm-like structure of hopper was not obvious.

Reversed.

1. Patents \Leftrightarrow 314(5)

Obviousness in patent dispute is question of law.

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2. Patents \Leftrightarrow 324.5

Claim construction in patent dispute is question of law reviewed *de novo* when there are no underlying factual issues.

3. Statutes \Leftrightarrow 190

When statutory interpretation is at issue, plain and unambiguous meaning of statute prevails in absence of clearly expressed legislative intent to the contrary.

4. Patents \Leftrightarrow 101(4, 8)

When construing means-plus-function language in patent claim, one must look to specification and interpret that language in light of corresponding structure, material, or acts described and equivalent to extent that the specification provides that such disclosure regardless of context in which interpretation arises; overruling *In re Lundberg*, 244 F.2d 648; *In re Arbeit*, 206 F.2d 947. 35 U.S.C.A. § 112.

5. Patents \Leftrightarrow 101(4)

Patent and Trademark Office may not disregard structure disclosed in specification corresponding to means-plus-function language when rendering patentability determination. 35 U.S.C.A. § 112.

6. Patents \Leftrightarrow 16.14

Industrial dust collector implementing flexible wall, diaphragm-like structure to loosen hardened dust that gathered on hopper wall was not obvious in view of previously patented dust collector with rigid hopper walls. 35 U.S.C.A. § 112.

R. Carl Moy, Merchant, Gould, Smith, Edell, Welter & Schmidt, P.A., of Minneapolis, Minnesota, argued for appellant.

Fred E. McKelvey, Solicitor, Office of the Solicitor, of Arlington, Virginia, argued for appellee. With him on the brief were Richard E. Schafer, Associate Solicitor and James T. Carmichael, Assistant Solicitor. Of counsel was Albin F. Drost.

Herbert I. Cantor, Wegner, Cantor, Mueller & Player, of Washington, D.C., was on the brief for Amicus Curiae, Bar Association of the District of Columbia. With him on the

brief were John W. Schneller, Chair, Patent, Trademark and Copyright Section and Anthony W. Shaw, Chair, Amicus Committee.

William L. LaFuze, Vinson & Elkins, of Houston, Texas, was on the brief for Amicus Curiae, American Intellectual Property Law Association. With him on the brief were Nancy J. Linck, Cushman, Darby & Cushman, Washington, D.C., Harold C. Wegner, Wegner, Cantor, Mueller & Player, Washington, D.C. and H. Ross Workman, Workman, Nydegger & Jensen, of Salt Lake City, Utah, of counsel.

Before NIES, Chief Judge, and RICH, NEWMAN, ARCHER, MAYER, MICHEL, PLAGER, LOURIE, CLEVENGER, RADER, and SCHALL, Circuit Judges.

RICH, Circuit Judge.

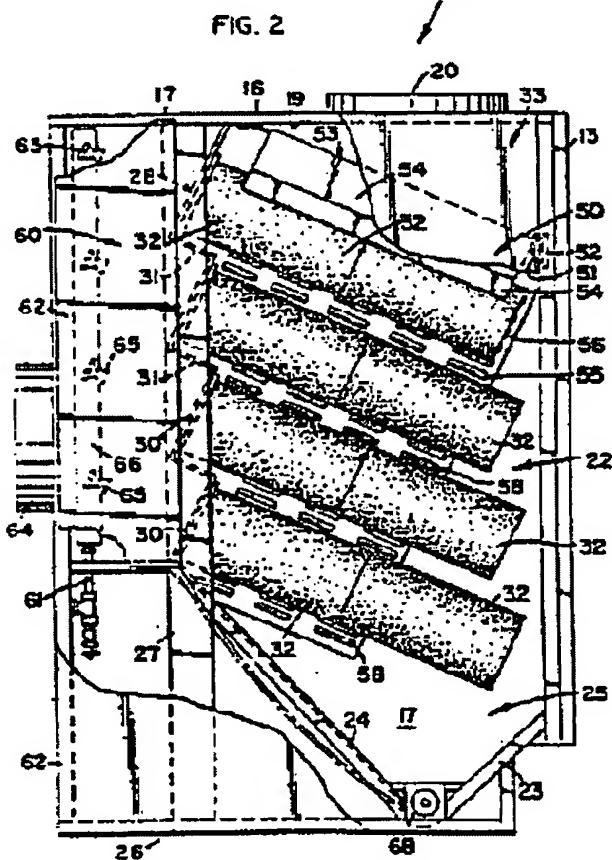
The Donaldson Company (Donaldson) appeals from the January 30, 1991 decision of the Board of Patent Appeals and Interferences (Board) of the United States Patent and Trademark Office (PTO), reaffirmed on reconsideration on April 17, 1991, sustaining the Examiner's rejection of claim 1 of reexamination application Serial No. 90/001,776¹ (Schuler application) under 35 U.S.C. § 103. We reverse.

I. BACKGROUND

A. The Invention

The present invention relates to industrial air-filtering devices often referred to as "dust collectors." Fig. 2 of the Schuler application is reproduced below.

FIG. 2



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In operation, dust-laden air enters dirty-air chamber (22) through air inlet (20) at the top, passes through filters (32), and then exits through clean-air outlet (64) at the left. During this process, dust is collected on the outside of the filters. To periodically dislodge accumulated dust from the filters, the Schuler collector includes valve and nozzle assemblies (65), which direct jets of compressed air into the hollow interior of each filter. In doing so, the normal direction of air flow is reversed, thus dislodging a substantial portion of the dust accumulated on the outside of each filter. The dislodged dust then falls through the dirty-air chamber and accumulates at the bottom of the chamber in hopper (25), where it is removed by auger screw (68).

One problem with conventional collectors is that the dust accumulated in the hopper tends to harden or cake, thus interfering with the free movement of the accumulated dust downward to the auger screw. To overcome this problem, the Schuler collector takes advantage of the fact that every pulse of air from the nozzles causes the pressure within the dirty-air chamber to increase momentarily. At least one wall of the hopper of the Schuler collector (24) is made from a flexible material which in essence transforms the hopper into a diaphragm-like structure which expands outward in response to the temporary pressure increases. This movement breaks up any dust that may have hardened or caked onto the hopper. This flexible-wall, diaphragm-like structure also provides the additional advantages of deadening the sounds of the cleaning pulses and expanding the volume of the dirty-air chamber, thus allowing the air pulses to act more vigorously on the filters.

Claim 1, the only claim on appeal, reads, with insertion of reference numerals in brackets, as follows:

An air filter assembly [10] for filtering air laden with particulate matter, said assembly [10] comprising:

a housing having a clean air chamber [60] and a filtering chamber [22], said housing having an upper wall [16], a closed bottom [26], and a plurality of side walls

2. The other references were U.S. Patent No. 4,410,109 issued to Lissy (Lissy patent) and U.S.

[17, 62] depending from said upper wall [16];

a clean air outlet [64] from said clean air chamber [60] in one of said side walls [62];

a dirty air inlet [20] to said filtering chamber [22] positioned in a wall [16] of said housing in a location generally above said clean air outlet [64];

means [28] separating said clean air chamber [60] from said filtering chamber [22] including means mounting a plurality of spaced-apart filter elements [32] within said filtering chamber [22], with each of said elements [32] being in fluid communication with said air outlet [64];

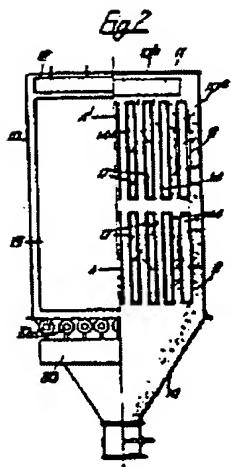
pulse-jet cleaning means [65], intermediate said outlet [64] and said filter elements [32], for cleaning each of said filter elements [32]; and

a lowermost portion [25] in said filtering chamber [22] arranged and constructed for the collection of particulate matter, said portion [25] having means [24], responsive to pressure increases in said chamber [22] caused by said cleaning means [65], for moving particulate matter in a downward direction to a bottommost point [68] in said portion [25] for subsequent transfer to a location exterior to said assembly [10]. [Emphasis ours.]

B. The Board Decision

In its initial January 30, 1991 decision, the Board relied solely upon the dust collector disclosed in U.S. Patent No. 3,421,295 (Swift patent) to affirm the Examiner's rejection of claim 1. The Board did not find the secondary references relied upon by the Examiner² necessary to sustain the rejection. Swift's dust collector, illustrated below by Fig. 2 of the Swift patent, uses pulses of compressed, high-energy gas to counteract normal filter flow. These pulses of compressed gas dislodge particulate matter from spaced-apart filter elements (14), and the dislodged particulate matter moves towards the bottom of the hopper (16).

Patent No. 2,732,099 issued to Davis (Davis patent).



At page 5 of its initial decision, the Board noted Donaldson's arguments that Swift fails to disclose the use in its dust collector of a flexible surface which flexes in response to the gas pulses therein, but stated that:

while such a flexible sloping surface is a recited feature of the apparatus of claims 2, 3, and 5, this is *not* the case as to the apparatus of claim 1. Thus, [Donaldson's] argument is of no moment to claim 1. Moreover, we are convinced that hopper 16 of the gas filtering apparatus of Swift is "responsive" to pressure increases in the apparatus caused by the jet-cleaning means whereby filtered particulate matter is caused to move in a downward direction. Thus, we agree with the examiner that there is no apparent distinction between the "lowermost portion" of the apparatus recited in claim 1 and the corresponding portion of the apparatus of Swift.

Thus, the Board did not interpret the "means, responsive to pressure increases in said chamber caused by said cleaning means, for moving particulate matter in a downward direction" language recited in the last paragraph of claim 1 as limited to the flexible wall, diaphragm-like structure disclosed in Schuler's specification, and equivalents thereof. Indeed, the Board specifically stated at page 2 of its decision on reconsideration mailed April 17, 1991:

It is axiomatic that particular features or limitations appearing in the specification are *not* to be read into the claims of an

application. [citations omitted] Thus, contrary to [Donaldson's] argument, a flexible sloping surface is *not* a feature of the air filtering apparatus of claim 1 which distinguishes it over the air filtering apparatus of Swift.

C. Donaldson's Assertions

For purposes of this appeal, Donaldson effectively concedes that Swift teaches or suggests each and every element of the apparatus recited in Schuler's claim 1 except for the "means, responsive to pressure increases in said chamber caused by said cleaning means, for moving particulate matter in a downward direction" recited in the last segment of claim 1. As to this limitation, Donaldson argues that the Board erred in holding that Swift teaches or suggests such a means as it is described in Schuler's specification. Donaldson further argues that the Board's error in this regard is the result of a fundamental legal error by the Board, namely the Board's failure to obey the statutory mandate of 35 U.S.C. § 112, paragraph six, in construing this claim.

II. DISCUSSION

A. Standard of Review

[1, 2] Obviousness under section 103 is a question of law that this court reviews de novo. *In re Woodruff*, 919 F.2d 1575, 1577, 16 USPQ2d 1934, 1935 (Fed.Cir.1990). Similarly, our precedent is that claim construction, when, as here, there are no underlying factual issues, is also a question of law that we review de novo. *Kahnman v. Kimberly-Clark Corp.*, 713 F.2d 760, 771, 218 USPQ 781, 789 (Fed.Cir.), *cert. denied*, 465 U.S. 1026, 104 S.Ct. 1284, 79 L.Ed.2d 687 (1984). In this case, the PTO erred in its construction of the "means-plus-function" language recited in the last segment of Schuler's claim 1, and this error consequently led the PTO to impose an improper obviousness rejection.

B. 35 U.S.C. § 112, Paragraph Six

[3] When statutory interpretation is at issue, the plain and unambiguous meaning of a statute prevails in the absence of clearly

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expressed legislative intent to the contrary. See *Mansell v. Mansell*, 490 U.S. 581, 592, 109 S.Ct. 2023, 2030, 104 L.Ed.2d 675 (1989); *Hceanet Aktiengesellschaft v. Quigg*, 917 F.2d 522, 526, 16 USPQ2d 1549, 1552 (Fed. Cir. 1990). The statutory language at issue in this case reads:

An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof. [Emphasis ours.]

35 U.S.C. § 112, paragraph 6 (1988).

[4] The plain and unambiguous meaning of paragraph six is that one construing means-plus-function language in a claim must look to the specification and interpret that language in light of the corresponding structure, material, or acts described therein, and equivalents thereof, to the extent that the specification provides such disclosure. Para-

3. There is no evidence that, at the time of the Act of July 24, 1965, Pub.L. No. 89-83, § 9, 1965 U.S.C.C.A.N. (79 Stat.) 259, or the Act of Nov. 14, 1975, Pub.L. No. 94-131, § 7, 1975 U.S.C.C.A.N. (89 Stat.) 685, which reenacted the third paragraph of section 112, now the sixth paragraph, Congress was specifically aware of the PTO's allegedly sweeping practice of interpreting means-plus-function language as reading on each and every means of performing that function, or of any CCPA decision condoning such a practice, and we do not find this reenactment without awareness to indicate clear Congressional approval or disapproval. See *AFL-CIO v. Brock*, 835 F.2d 912, 916 n. 6 (D.C.Cir. 1987) (stating that no case has rested merely on presumptive knowledge, noting that, in *Lindahl v. OPM*, 470 U.S. 768, 782-86, 105 S.Ct. 1620, 1628-31, 84 L.Ed.2d 674 (1984), relied upon by the Commissioner here, there was evidence in the legislative history that Congress was aware of the particular interpretation at issue), citing with approval, C. Sands, *SUTHERLAND ON STATUTORY CONSTRUCTION*, § 49.09 (4th ed. 1984) (rule of implied adoption of agency interpretation does not apply where nothing indicates that the legislature had its attention directed to such interpretation upon reenactment.); see also *General American Transp. v. Interstate Commerce Comm.*, 872 F.2d 1048, 1053 (D.C.Cir. 1989). In addition, P.J. Federico's post-ACI "Commentary on the New Patent Act," 35 U.S.C.A. § 1 (1954 ed., West), reprinted in 75 JPOS 162 (1993), is

graph six does not state or even suggest that the PTO is exempt from this mandate, and there is no legislative history indicating that Congress intended that the PTO should be.³ Thus, this court must accept the plain and precise language of paragraph six. See *Mansell* *supra*; see also *Diamond v. Chakrabarty*, 447 U.S. 303, 308, 100 S.Ct. 2204, 2207, 65 L.Ed.2d 144 (1980) ("courts 'should not read into the patent laws limitations and conditions which the legislature has not expressed'"), quoting *United States v. Dubilier Condenser Corp.*, 289 U.S. 178, 199, 53 S.Ct. 554, 561, 77 L.Ed. 1114 (1933). Accordingly, because no distinction is made in paragraph six between prosecution in the PTO and enforcement in the courts, or between validity and infringement, we hold that paragraph six applies regardless of the context in which the interpretation of means-plus-function language arises, i.e., whether as part of a patentability determination in the PTO or as part of a validity or infringement determination in a court.⁴ To the extent that *In re Lundberg*, 244 F.2d 543, 113 USPQ 530 (CCPA 1957), *In re Arbeit*, 206 F.2d 947, 99

not legislative history per se that may be relied upon to indicate Congressional intent. Even if it were, the comments contained therein do not suggest that Federico knew of any particular intent by Congress regarding the manner in which the sixth paragraph, then the third paragraph, should be applied. In this particular, he was merely stating his personal views.

4. Accord, *Arrhythmia Research Technology*, 958 F.2d 1053, 1060, 22 USPQ2d 1033, 1038 (Fed. Cir. 1992) (infringement determination); *In re Bond*, 910 F.2d 831, 833, 15 USPQ2d 1566, 1568 (Fed.Cir.1990) (patentability over prior art determination); *In re Iwahashi*, 888 F.2d 1370, 1375, 12 USPQ2d 1908, 1912 (Fed.Cir.1989); *Johnson v. Ivac Corp.*, 885 F.2d 1574, 1580, 12 USPQ2d 1382, 1386 (Fed.Cir.1989) (infringement determination); *In re Mayer*, 688 F.2d 789, 796, 215 USPQ 193, 199 (CCPA 1982) (section 101 patentability determination); *In re Knowlton*, 481 F.2d 1357, 1366, 178 USPQ 486, 492-93 (CCPA 1973) (patentability determination as to section 112 and prior art); *In re Foster*, 438 F.2d 1011, 1016, 169 USPQ 99, 102 (CCPA 1971) (section 101 patentability determination); *In re Bernhart*, 417 F.2d 1395, 1399, 163 USPQ 611, 615 (CCPA 1969) (section 101 patentability determination); *In re Prater*, 415 F.2d 1393, 1406, 162 USPQ 541, 551-52 (CCPA 1969) (section 103 patentability determination). See also generally R. Carl Muy, *The Interpretation of Means Expressions During Prosecution*, 68 JPOS 246 (1986).

USPQ 128 (CCPA 1953), or any other precedent of this court suggests or holds to the contrary, it is expressly overruled.

The Commissioner argues that his interpretation is entitled to deference in view of what the Commissioner alleges is the PTO's sweeping and long-standing practice of not applying paragraph six during examination. We disagree. The fact that the PTO may have failed to adhere to a statutory mandate over an extended period of time does not justify its continuing to do so. In addition, paragraph six facially covers every situation involving the interpretation of means-plus-function language, and the Commissioner's attempts to create an ambiguity in paragraph six where none exists are to no avail. The fact that paragraph six does not specifically state that it applies during prosecution in the PTO does not mean that paragraph six is ambiguous in this respect. Quite the contrary, we interpret the fact that paragraph six fails to distinguish between prosecution in the PTO and enforcement in the courts as indicating that Congress did not intend to create any such distinction.

In addition, section 112 as a whole relates to requirements for the specification and claims without regard to whether a patent or patent application is involved. Moreover, section 112 is found in Chapter 11 of Title 35, titled "Application for Patent," which supports our holding that section 112, paragraph six, governs the interpretation of "means" clauses in a claim for a combination when being examined in pending applications.

The Commissioner argues that Congress enacted paragraph six to codify the "reverse doctrine of equivalents" for means-plus-function claim language, a claim interpretation tool which finds application only in the litigation context, wherefore Congress must have intended paragraph six to apply only in the context of post-issuance infringement and va-

5. Of course, this is not to say that this may not have been one of the results of enacting this paragraph. In *Johnston v. IVAC Corp.*, 885 F.2d 1574, 1580, 12 USPQ2d 1382, 1386-87 (Fed.Cir. 1989), this court noted that paragraph six effectively restricts the scope that one would attribute to means-plus-function language if one were to read it in a vacuum without reference to the specification.

lidity actions. We see no merit in this imaginative reasoning, and no support for it has been cited. The record is clear on why paragraph six was enacted. In *Halliburton Oil Well Cementing Co. v. Walker*, 329 U.S. 1, 67 S.Ct. 6, 91 L.Ed. 3 (1946), the Supreme Court held that means-plus-function language could not be employed at the exact point of novelty in a combination claim. Congress enacted paragraph six, originally paragraph three, to statutorily overrule that holding. See *In re Fuellerer*, 319 F.2d 259, 264 n. 11, 138 USPQ 217, 222 n. 11 (CCPA 1963) (noting that it was Congress's intent to restore the law regarding broad functional language in combination claims to its state prior to *Halliburton*). The fact that the question of how to treat means-plus-function language came to Congress's attention through the context of infringement litigation does not suggest that Congress did not intend paragraph six to apply to all interpretations of means-plus-function claim language. Furthermore, there is no legislative history suggesting that Congress's purpose in enacting paragraph six was to codify the reverse doctrine of equivalents,⁵ and thus there is no reason to believe that Congress intended to limit the application of paragraph six to post-issuance claim interpretation.

[5] Contrary to suggestions by the Commissioner, our holding does not conflict with the principle that claims are to be given their "broadest reasonable interpretation" during prosecution. See, e.g., *In re Prater*, 415 F.2d 1393, 1404-05, 162 USPQ 541, 550-51 (CCPA 1969).⁶ Generally speaking, this claim interpretation principle remains intact. Rather, our holding in this case merely sets a limit on how broadly the PTO may construe means-plus-function language under the rubric of "reasonable interpretation." Per our holding, the "broadest reasonable interpretation" that an examiner may give means-plus-function language is that statutorily mandated in

6. Of interest, the *Prater* court distinguished the apparatus claim therein from the process claims at issue on the basis that the apparatus claim employed "typical means-plus-function language as expressly permitted by the third paragraph [now sixth] of 35 U.S.C. § 112." *In re Prater*, 415 F.2d at 1406, 162 USPQ at 551-52.

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paragraph six. Accordingly, the PTO may not disregard the structure disclosed in the specification corresponding to such language when rendering a patentability determination.

Our holding similarly does not conflict with the second paragraph of section 112.⁷ Indeed, we agree with the general principle espoused in *In re Lundberg*, 244 F.2d at 547-48, 113 USPQ at 534 (CCPA 1979), that the sixth paragraph of section 112 does not exempt an applicant from the requirements of the first two paragraphs of that section. Although paragraph six statutorily provides that one may use means-plus-function language in a claim, one is still subject to the requirement that a claim "particularly point out and distinctly claim" the invention. Therefore, if one employs means-plus-function language in a claim, one must set forth in the specification an adequate disclosure showing what is meant by that language. If an applicant fails to set forth an adequate disclosure, the applicant has in effect failed to particularly point out and distinctly claim the invention as required by the second paragraph of section 112.

Also contrary to suggestions by the Commissioner, our holding does not conflict with the general claim construction principle that limitations found only in the specification of a patent or patent application should not be imported or read into a claim. See *In re Priest*, 582 F.2d 33, 37, 199 USPQ 11, 15 (CCPA 1978). The Commissioner confuses impermissibly imputing limitations from the specification into a claim with properly referring to the specification to determine the meaning of a particular word or phrase recited in a claim. See *E.I. Du Pont de Nemours & Co. v. Phillips Petroleum Co.*, 849 F.2d 1430, 1433, 7 USPQ2d 1129, 1131 (Fed.Cir. 1988) (discusses importance of distinguishing between the two). What we are dealing with in this case is the construction of a limitation

7. The second paragraph of 35 U.S.C. § 112 reads:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

8. The word "equivalent" in 35 U.S.C. § 112, paragraph 6, should not be confused with the

already in the claim in the form of a means-plus-function clause and a statutory mandate on how that clause must be construed.

C. Application of Paragraph Six to Claims

[6] For the foregoing reasons, the PTO was required by statute to look to Schuler's specification and construe the "means" language recited in the last segment of claim 1 as limited to the corresponding structure disclosed in the specification and equivalents thereof.⁸ The particular means language of claim 1 at issue reads:

means, responsive to pressure increases in said chamber caused by said cleaning means, for moving particulate matter in a downward direction to a bottommost point in said [lowermost] portion for subsequent transfer to a location exterior to said assembly.

In the "Summary of the Invention" section of his specification, Schuler states:

A lowermost portion of the assembly is arranged and constructed to collect the removed particulate matter. The collection portion includes a sloping surface constructed of a material which flexes in response to the pressure differentials created within the chamber during the operation of the pulse-jet cleaning means.

....

[t]he sloping surface of the collection portion of the assembly moves outward, or flexes, as the pressure increases within the chamber with each operation of the pulse-jet means. The flexing movement allows the air entraining the dust from the filter element to travel towards the collection area, thereby helping to prevent the removed dust from being re-deposited on a neighboring filter element. Also, the flexing surface dampens the noise and vibrations of the pulse jet cleaning means, and moves the dust collected on its surface

doctrine of equivalents. *D.M.I., Inc. v. Perre & Co.*, 755 F.2d 1570, 1575, 225 USPQ 236, 239 (Fed.Cir.1985); see also *Pearlval Corp. v. Durand-Wayland, Inc.*, 833 F.2d 931, 933-34, 4 USPQ2d 1737, 1741 (Fed.Cir.) (en banc), cert. denied, 485 U.S. 961, 108 S.Ct. 1226, 99 L.Ed.2d 426 (1988).

towards the collection area for subsequent removal from the assembly itself. [Emphasis ours.]

Schuler Patent, Col. 2, lines 6-12, 28-39. In discussing a preferred embodiment of his dust collector, Schuler further describes the "means, responsive to pressure" recited in claim 1 as follows:

The larger surface area 24 is designed and arranged to act as a diaphragm which is movably responsive to the pressure differentials created within the dirty air chamber 22 by the operation of the pulse jet cleaning means 65, 66. The diaphragm 24 is preferably made from a flexible, reinforced rubber sheet material. However, any material sufficiently strong and flexible could be used, i.e., a relatively thin metal panel which will flex. The diaphragm movement caused by the operation of the pulse jet cleaning means will be explained in detail below.

Schuler Patent, Col. 6, lines 21-31. The further explanation referred to reads:

During the operation of the pulse-jet cleaning means the larger, sloping surface or diaphragm 24 moves outward or away from the filter elements 32 in response to the increase in pressure within the dirty air chamber 22. This outward flexing is shown in broken lines in FIG. 2. As the pressure diminishes, the surface 24 flexes back to its normal position.

The pressure-responsive, flexing movement of the larger sloping surface 24 accomplishes four important functions: (1) the movement allows air entraining the removed dust to move downwardly towards the hopper; (2) it helps prevent the removed dust and particulate matter from being re-deposited onto adjacent elements; (3) it helps to dampen the noise and the vibrations of the pulse-jet cleaning means; and (4) it helps to move the particulate matter which has settled on the diaphragm surface towards the auger screw. As the particulate matter accumulates in the lowermost portion 25 upon the auger screw 68, it is removed, by the operation of the auger screw 68, to a location exterior to the filter assembly. There is nearly zero dirty air velocity at the point adjacent to

the auger screw, as a result of the dirty air inlet not being in nor even adjacent to the particulate matter collection area of the filter assembly.

Schuler Patent, Col. 7, lines 42-66.

A review of the foregoing excerpts leads to the inescapable conclusion that Schuler's specification defines the "means, responsive to pressure increases in said chamber . . . , for moving particulate matter in a downward direction" language recited in claim 1 as a flexible-wall, diaphragm-like structure, such that the hopper is made up of at least one flexible wall which expands outward upon pressure increases, thus causing caked-on dust to break loose from the wall of the hopper and fall towards the auger screw due to gravity.

D. *Swift*

The Swift collector does not teach or suggest the flexible-wall, diaphragm-like structure claimed by Schuler. Indeed, there is no teaching or suggestion in Swift that the hopper walls therein be anything but rigid and non-responsive to any pressure increases within the collector. Consequently, it would not have been obvious to one of ordinary skill in the art to modify Swift to obtain Schuler's flexible-wall, diaphragm-like structure. In this regard, we note that the Board itself specifically held at page 6 of its initial decision that the examiner had failed to establish a *prima facie* case of obviousness as to claims 2, 3, and 5, because Swift and the other references relied upon by the examiner

fail to disclose or render obvious the feature of the lowermost portion of the claimed apparatus comprising the flexible sloping surface which flexes in response to increases in pressure in the apparatus caused by the pulse-jet cleaning means whereby filtered particulate matter is moved in a downward direction.

Notwithstanding this explicit holding by the Board that Swift fails to teach or suggest the flexible-wall, diaphragm-like structure that Schuler discloses in his specification as corresponding to the "means" language recited in the last segment of claim 1, the Commissioner nevertheless argues that the examiner found, and the Board allegedly im-

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plicitly agreed, that Swift's hopper walls respond to jet-cleaning pressure increases by vibrating, and that Donaldson has failed to establish that this allegedly responsive structure is not an "equivalent" to Schuler's disclosed flexible-wall, diaphragm-like structure. The Commissioner further contends that the slanted hopper walls in Swift's collector satisfy the "means, responsive to pressure" language of claim 1.

The Commissioner's arguments appear to address concepts of anticipation under 35 U.S.C. § 102. However, neither the Examiner nor the Board imposed an anticipation rejection under section 102. The only rejection before this court is one of obviousness under section 103.

Nevertheless, as explained previously, section 112, paragraph six, requires us and the PTO to construe the "means, responsive to pressure" language recited in claim 1 as limited to a flexible-wall, diaphragm-like structure as disclosed in Schuler's specification, or an "equivalent" thereof. In this regard, the Commissioner has failed to establish the existence in conventional hopper structures like Swift's of any inherent vibrations resulting from pulse-jet cleaning sufficient to loosen hardened dust that gathers on hopper walls.⁹ Thus, because the Commissioner's unsupported assertion that Swift's hopper walls would vibrate in response to pressure increases caused by pulse-jet cleaning is mere speculation unsupported by any rational basis for believing it might be true, the burden clearly did not shift to Schuler to establish non-equivalence. Furthermore, the Commissioner has failed to persuade us that such vibration, even if it did occur, should be viewed as making Swift's hopper structure an "equivalent" of Schuler's flexible-wall, diaphragm-like structure.

As to the Commissioner's arguments regarding Swift's slanted hopper walls, we note that neither the examiner nor the Board ever asserted that these slanted walls by themselves represent an "equivalent" of Schuler's flexible-wall, diaphragm-like structure. In

9. We note that the Lissy patent discloses a dust collector in which the hopper walls thereof are actuated mechanically by vibrators to loosen caked-on dust so that it can fall to the bottom of the hopper. *Lissy Patent*, Col. 2, lines 4-8; Col. 4, lines 20-27. If conventional pulse-jet cleaning

addition, the Commissioner has failed to set forth any reasonable explanation as to how Swift's walls are "responsive to pressure increases."

In summary, Schuler's claimed collector would not have been obvious in view of Swift's collector having hopper walls which are rigid and non-responsive to pressure increases within the collector. In addition, even if the issue of anticipation under section 102 were before us, which it is not, the Commissioner could not have argued anticipation because he has failed to establish that the rigid hopper wall structure in Swift's collector is an "equivalent" of the flexible wall, diaphragm-like hopper structure in Schuler's claim 1 collector.

CONCLUSION

For the foregoing reasons, we hold, as a matter of law, that Swift does not render the structure defined by claim 1 obvious under 35 U.S.C. § 103, and therefore we reverse the decision of the Board. On the record before us, we see no reason to remand this case for further findings as to "equivalents" as suggested by the Commissioner.

REVERSED.



DAIRYLAND POWER COOPERATIVE,
Plaintiff-Appellant,

v.

The UNITED STATES, Defendant-
Appellee.

No. 93-5131.

United States Court of Appeals,
Federal Circuit.

Feb. 15, 1994.

Purchaser of nuclear reactor plant from federal government brought action for rescis-

provided sufficient vibrations to loosen caked-on dust, Lissy presumably would not have found it necessary to add vibrators. Similarly, Davis presumably would not have found it necessary to use the inflatable membrane described therein. *Davis Patent*, Col. 4, lines 23-58.